GATE Agricultural Engineering

Sample Paper – 9

Duration: 128 Minutes **Maximum Marks: 72**

Instructions

- This paper contains **46 questions** covering the core **Agricultural Engineering** subject of the GATE paper conducted by the IITs and IISc (General Aptitude and Engineering Mathematics are provided as separate papers).
- **Q1–Q20 carry 1 mark each** and **Q21–Q46 carry 2 marks each**, for a total of **72 marks**.
- Each question carries **negative marking of one-third of its allotted marks**: a wrong 1-mark question costs **0.33** and a wrong 2-mark question costs **0.67**. Unattempted questions carry no penalty.
- Every question here is a single-correct **MCQ**. The real GATE paper also has Multiple Select (MSQ) and Numerical Answer Type (NAT) questions, and **those carry no negative marking**.
- Attempt this paper in one timed sitting of about **128 minutes**, the share this core subject earns at GATE's overall pace of 180 minutes for 65 questions. Take $g = 9.81$ m/s^2, density of water $\rho_w = 1000$ kg/m^3 and unit weight of water $\gamma_w = 9.81$ kN/m^3 unless stated otherwise.

Farm Machinery & Power

Q1. A tractor drive wheel has a theoretical (no-slip) forward speed of 8 km/h, but the actual forward speed measured on the field is 6 km/h. The wheel slip is: **[1 mark]**

(A) 33.3%

(B) 20%

(C) 25%

(D) 75%

Q2. A tractor engine develops a brake power of 40 kW. If the mechanical efficiency of the engine is 80%, the indicated power developed inside the cylinders is: **[1 mark]**

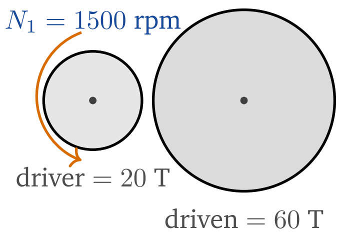
(A) 32 kW

(B) 45 kW

(C) 50 kW

(D) 8 kW

Q3. In the spur-gear reduction shown, the driver pinion has 20 teeth and turns at 1500 rpm, while the driven gear has 60 teeth. The output speed of the driven gear is: **[1 mark]**



(A) 500 rpm

(B) 4500 rpm

(C) 1500 rpm

(D) 333 rpm

Q4. An engine cylinder has a bore (diameter) of 100 mm and a stroke of 120 mm. The swept (displacement) volume of one cylinder is nearest to: **[1 mark]**

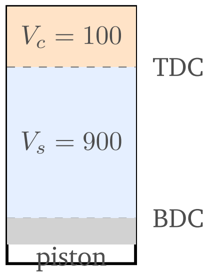
(A) 1885 cm^3

(B) 942 cm^3

(C) 120 cm^3

(D) 785 cm^3

Q5. The engine cylinder shown has a swept volume of 900 cm^3 (between top and bottom dead centre) and a clearance volume of 100 cm^3 above the top dead centre. The compression ratio of the engine is: **[1 mark]**



(A) 9

(B) 8

(C) 90

(D) 10

Q6. Which one of the following implements is used chiefly for the *puddling* operation in the preparation of wetland (transplanted) rice fields? **[1 mark]**

(A) Cage wheel (puddler)

(B) Mouldboard plough

(C) Seed drill

(D) Disc harrow

Q7. A tractor-mounted mouldboard plough has 3 bottoms, and each bottom cuts a furrow slice 30 cm wide. The total width of soil worked in a single pass is: **[1 mark]**

(A) 0.30 m

(B) 0.90 m

(C) 0.10 m

(D) 1.20 m

Q8. A field of area 4 ha is to be ploughed by an implement whose effective field capacity is 0.5 ha/h. The total time required to plough the whole field is: **[1 mark]**

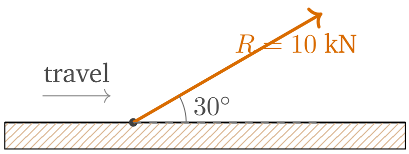
(A) 2 h

(B) 4 h

(C) 0.125 h

(D) 8 h

Q9. A hitch pull of magnitude $R = 10$ kN acts on an implement at an angle of 30° above the horizontal direction of travel, as shown. The vertical (lifting) component of this pull is (take $\sin 30^\circ = 0.50$): **[1 mark]**



(A) 5.0 kN

(B) 8.66 kN

(C) 10.0 kN

(D) 2.5 kN

Q10. A crop is planted with a row-to-row spacing of 60 cm and a plant-to-plant spacing of 20 cm within the row. The plant population per hectare is: **[1 mark]**

(A) 10,000

(B) 30,000

(C) 1,20,000

(D) 83,333

Q11. Which spray nozzle produces a narrow flat-fan spray pattern and is preferred for the uniform band application of herbicides on the soil surface? **[1 mark]**

(A) Hollow-cone nozzle

(B) Flat-fan nozzle

(C) Solid-cone nozzle

(D) Flood-jet nozzle

Q12. In a two-stroke-cycle internal-combustion engine, the number of power (expansion) strokes produced for every one revolution of the crankshaft is: **[1 mark]**

(A) 1

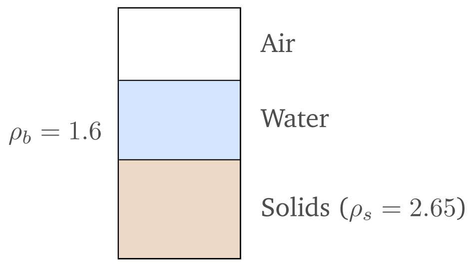
(B) 2

(C) 0.5

(D) 4

Soil & Water Conservation Engineering

Q13. A soil sample has a dry bulk density of 1.6 g/cm^3 and a particle density of 2.65 g/cm^3, as represented in the three-phase diagram shown. The porosity of the soil is nearest to: **[1 mark]**



(A) 60%

(B) 40%

(C) 16%

(D) 26.5%

Q14. A soil has a porosity of 0.40. The void ratio e of this soil is: **[1 mark]**

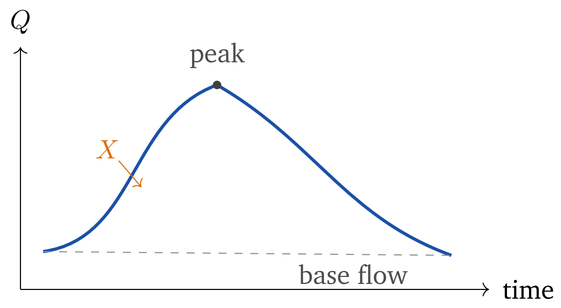
(A) 0.40

(B) 1.50

(C) 0.60

(D) 0.667

Q15. In the single-peaked storm hydrograph shown, the portion marked X (the part of the curve that lies before the peak and rises from the base flow up towards the crest) is called the: **[1 mark]**



(A) recession (falling) limb

(B) rising limb

(C) base flow

(D) peak discharge

Q16. The time required for surface runoff to travel from the hydraulically most remote point of a watershed to its outlet is termed the: **[1 mark]**

(A) basin lag time

(B) base time of the hydrograph

(C) time of concentration

(D) recession time

Q17. In the Universal Soil Loss Equation $A = R\,K\,LS\,C\,P$, the factor that accounts for the effect of erosion-control practices such as contouring, strip cropping and terracing is: **[1 mark]**

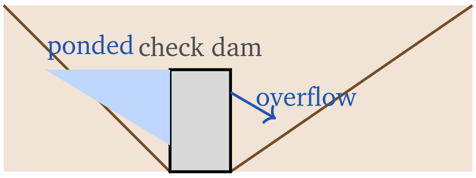
(A) the cover-management factor C

(B) the support-practice factor P

(C) the soil-erodibility factor K

(D) the rainfall-erosivity factor R

Q18. A masonry check dam is constructed across an actively eroding gully, as shown. The main purpose of such a structure is to: **[1 mark]**



(A) reduce the flow velocity and trap sediment, thereby stabilising the gully bed

(B) increase the runoff leaving the gully

(C) store irrigation water for the whole cropping season

(D) serve only as a foot bridge across the gully

Q19. On a sloping field the ground surface drops by a vertical height of 2 m over a horizontal distance of 50 m. The land slope expressed as a percentage is: **[1 mark]**

(A) 4%

(B) 25%

(C) 2%

(D) 0.04%

Q20. The maximum velocity of flow that a grassed waterway can carry without causing erosion of its vegetated lining is called the: **[1 mark]**

(A) critical velocity

(B) terminal velocity

(C) mean velocity

(D) permissible (non-erosive) velocity

Soil & Water Conservation Engineering (continued)

Q21. A rainfall event of 60 mm depth over a small watershed produces a direct surface runoff of 24 mm. The runoff coefficient (ratio of runoff to rainfall) for this storm is: **[2 marks]**

(A) 0.60

(B) 2.50

(C) 0.40

(D) 0.24

Q22. A grassed waterway is designed to carry a peak discharge of 0.5 m^3/s at a permissible mean velocity of 1.0 m/s. The required cross-sectional area of flow is: **[2 marks]**

(A) 0.25 m^2

(B) 2.0 m^2

(C) 0.5 m^2

(D) 1.5 m^2

Q23. A storm produces a direct runoff depth of 40 mm over a watershed of area 25 ha. The total volume of surface runoff generated is: **[2 marks]**

(A) 5000 m^3

(B) 10000 m^3

(C) 1000 m^3

(D) 100000 m^3

Irrigation & Drainage Engineering

Q24. For a certain crop the total available water held in the root zone is 10 cm. Irrigation is scheduled when 50% of this available water has been depleted. The net irrigation depth to be applied at each irrigation is: **[2 marks]**

(A) 10 cm

(B) 2.5 cm

(C) 20 cm

(D) 5 cm

Q25. A crop has a net irrigation depth of 50 mm applied at each irrigation, and its peak evapotranspiration rate is 5 mm/day. The irrigation interval (frequency) at the peak-demand period is: **[2 marks]**

(A) 5 days

(B) 250 days

(C) 2.5 days

(D) 10 days

Q26. The duty of irrigation water for a crop is 800 hectares per cumec. The discharge required at the field head to irrigate a command area of 400 ha is: **[2 marks]**

(A) 0.25 m^3/s

(B) 2.0 m^3/s

(C) 0.5 m^3/s

(D) 1.0 m^3/s

Q27. For a crop the base period is 120 days and the duty of water is 800 hectares per cumec. Using the relation $\Delta = \frac{8.64\,B}{D}$ (with Δ in metres, B in days and D in ha/cumec), the delta (total depth of water) for the crop is nearest to: **[2 marks]**

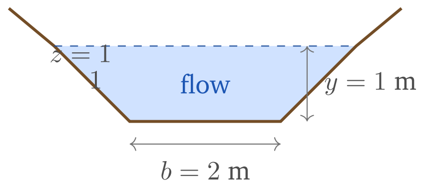
(A) 0.65 m

(B) 2.60 m

(C) 1.30 m

(D) 8.64 m

Q28. Water flows in the trapezoidal earthen field channel shown, which has a bottom width of 2 m, a flow depth of 1 m and side slopes of 1 horizontal to 1 vertical ($z = 1$). The cross-sectional area of flow is: **[2 marks]**



(A) 2 m^2

(B) 3 m^2

(C) 4 m^2

(D) 6 m^2

Q29. A centrifugal pump delivers 50 L/s of water against a total head of 10 m. The useful water (output) power delivered by the pump is nearest to (take $\rho_w = 1000$ kg/m^3, $g = 9.81$ m/s^2): **[2 marks]**

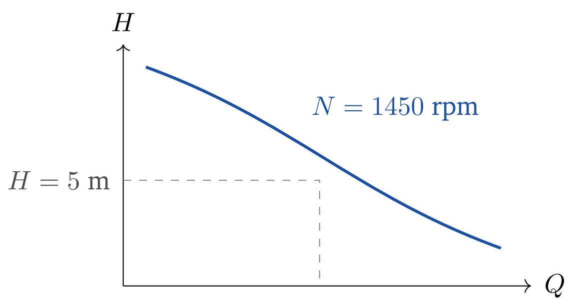
(A) 9.81 kW

(B) 4.9 kW

(C) 2.45 kW

(D) 6.5 kW

Q30. A centrifugal pump running at 1450 rpm develops a head of 5 m at its operating point, shown on the head–discharge curve. If the speed is raised to 2900 rpm, the head developed (predicted by the pump affinity laws, $H \propto N^2$) becomes: **[2 marks]**



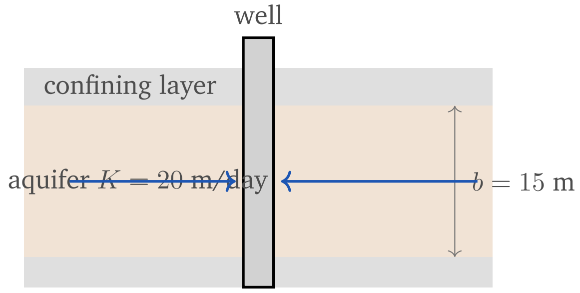
(A) 5 m

(B) 10 m

(C) 40 m

(D) 20 m

Q31. Water flows to a fully penetrating well through a confined aquifer of hydraulic conductivity 20 m/day and saturated thickness 15 m, as shown. The transmissivity of the aquifer is: **[2 marks]**



(A) $1.33\ \text{m}^2/\text{day}$

(B) $35\ \text{m}^2/\text{day}$

(C) $300\ \text{m}^2/\text{day}$

(D) $150\ \text{m}^2/\text{day}$

Q32. A drainage coefficient of 1.5 cm/day is to be provided for a low-lying agricultural area of 80 ha. The design discharge capacity of the drainage system is nearest to: **[2 marks]**

(A) $1.39\ \text{m}^3/\text{s}$

(B) $0.278\ \text{m}^3/\text{s}$

(C) $0.139\ \text{m}^3/\text{s}$

(D) $0.069\ \text{m}^3/\text{s}$

Q33. In an irrigation project the water-application efficiency is 80% and the water-conveyance efficiency is 75%. The overall (project) irrigation efficiency, taken as the product of the two, is: **[2 marks]**

(A) 80%

(B) 75%

(C) 155%

(D) 60%

Q34. Groundwater flows through a confined aquifer with a hydraulic conductivity of 10 m/day, under a hydraulic gradient of 0.05, across a flow cross-section of 20 m^2. Using Darcy's law $Q = K\,i\,A$, the discharge is: **[2 marks]**

(A) 10 m^3/day

(B) 200 m^3/day

(C) 0.5 m^3/day

(D) 2 m^3/day

Agricultural Processing & Food Engineering

Q35. A batch of grain weighing 500 kg has a moisture content of 20% on a wet basis. The mass of bone-dry matter contained in the batch is: **[2 marks]**

(A) 100 kg

(B) 480 kg

(C) 250 kg

(D) 400 kg

Q36. 1000 kg of paddy at 25% moisture (wet basis) is dried in a dryer to a final moisture content of 15% (wet basis). The mass of water that must be removed during drying is nearest to: **[2 marks]**

(A) 100 kg

(B) 250 kg

(C) 117.6 kg

(D) 150 kg

Q37. A grain sample has a moisture content of 20% on a wet basis. The equivalent moisture content of the grain expressed on a dry basis is: **[2 marks]**

(A) 20%

(B) 25%

(C) 16.7%

(D) 80%

Q38. The moisture in a wet solid that exists as a liquid in surface films and open capillaries and exerts a vapour pressure equal to that of pure water at the same temperature is called the: **[2 marks]**

(A) bound moisture

(B) equilibrium moisture

(C) free (unbound) moisture

(D) critical moisture

Q39. According to Kick's law of size reduction, the energy required to reduce the size of a solid material is proportional to: **[2 marks]**

(A) the logarithm of the size-reduction ratio, i.e. to $\ln\left(\frac{d_1}{d_2}\right)$

(B) the new surface area created during grinding

(C) the square of the feed particle diameter

(D) the reciprocal of the product diameter only

Q40. A grain-cleaning machine separates a mixture of sound grain and other particles on the basis of their difference in specific gravity, using an inclined oscillating deck through which air is blown. This machine is a: **[2 marks]**

(A) magnetic separator

(B) specific-gravity (gravity) separator

(C) disc separator

(D) spiral separator

Q41. A bucket elevator carries grain in buckets each holding 2 kg of grain, spaced 0.4 m apart along the belt, which moves at a linear speed of 1.6 m/s. The conveying capacity of the elevator is: **[2 marks]**

(A) 28.8 t/h

(B) 14.4 t/h

(C) 8 t/h

(D) 57.6 t/h

Q42. The heat required to raise the temperature of 50 kg of water by 20°C, taking the specific heat of water as 4.18 kJ/kg · K, is: **[2 marks]**

(A) 2090 kJ

(B) 4180 kJ

(C) 8360 kJ

(D) 1000 kJ

Q43. The heat required to evaporate 2 kg of water already at its boiling point of 100°C, taking the latent heat of vaporization of water as 2257 kJ/kg, is: **[2 marks]**

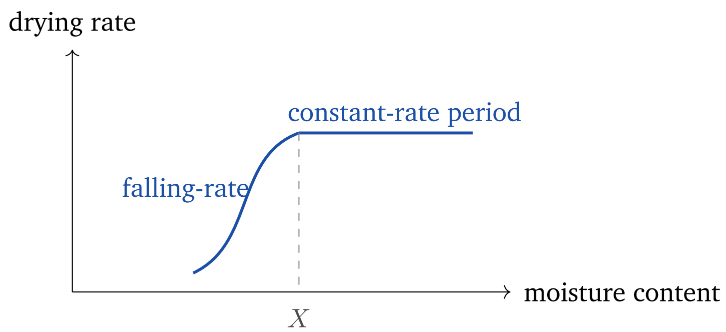
(A) 4514 kJ

(B) 2257 kJ

(C) 1128 kJ

(D) 9028 kJ

Q44. The drying-rate curve of a food material (drying rate plotted against moisture content) is shown. The moisture content marked X, at which the constant-rate period ends and the falling-rate period begins, is the: **[2 marks]**



(A) critical moisture content

(B) equilibrium moisture content

(C) free moisture content

(D) bound moisture content

Q45. The process in which milk is rapidly heated to about 138–$150°$C and held for only 2 to 4 seconds to achieve commercial sterility and a long shelf life is known as: **[2 marks]**

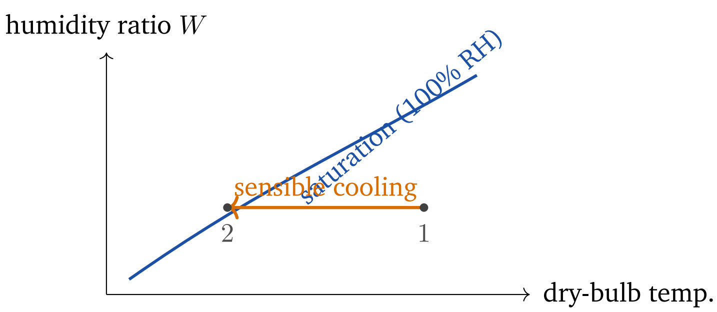
(A) LTLT (holder) pasteurization

(B) HTST pasteurization

(C) blanching

(D) UHT (ultra-high-temperature) sterilization

Q46. Moist air at a dry-bulb temperature of $30°$C is cooled by a sensible cooling process (no moisture added or removed), shown as the horizontal line 1–2 moving to the left on the psychrometric sketch. During this process the relative humidity of the air: **[2 marks]**



(A) increases

(B) decreases

(C) remains constant

(D) first decreases and then increases

Detailed Solutions

Q1.

Solution

Concept – wheel slip of a traction wheel: Slip is the fractional loss of forward travel of a driving wheel, $s = \frac{V_t - V_a}{V_t} \times 100\%$, where V_t is the theoretical (no-slip) speed and V_a the actual speed.

Step 1 – list the data: $V_t = 8$ km/h, $V_a = 6$ km/h.

Step 2 – find the speed difference: $V_t - V_a = 8 - 6 = 2$ km/h

Step 3 – write the slip formula: $s = \frac{V_t - V_a}{V_t} \times 100$

Step 4 – substitute the values: $s = \frac{2}{8} \times 100$

Step 5 – simplify the fraction: $\frac{2}{8} = 0.25$

Step 6 – convert to percentage: $s = 0.25 \times 100 = 25\%$

Final Answer: $s = 25\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept – mechanical efficiency of an engine: Mechanical efficiency relates the useful brake power (BP) at the shaft to the indicated power (IP) developed in the cylinders: $\eta_{mech} = \frac{\text{BP}}{\text{IP}}$, so $\text{IP} = \frac{\text{BP}}{\eta_{mech}}$.

Step 1 – list the data: BP $= 40$ kW, $\eta_{mech} = 80\% = 0.80$.

Step 2 – rearrange for indicated power: $\text{IP} = \frac{\text{BP}}{\eta_{mech}}$

Step 3 – substitute the values: $\text{IP} = \frac{40}{0.80}$

Step 4 – evaluate: $\text{IP} = 50$ kW

Step 5 – sense check: IP is larger than BP because friction inside the engine consumes part of the indicated power, which is consistent.

Final Answer: $\text{IP} = 50 \text{ kW} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – speed ratio of a gear pair: For a pair of meshing gears the speed is inversely proportional to the number of teeth: $N_1T_1 = N_2T_2$, so $N_2 = N_1\dfrac{T_1}{T_2}$.

Step 1 – list the data: Driver: $T_1 = 20$ teeth, $N_1 = 1500$ rpm. Driven: $T_2 = 60$ teeth.

Step 2 – write the relation: $N_2 = N_1 \times \dfrac{T_1}{T_2}$

Step 3 – substitute the values: $N_2 = 1500 \times \dfrac{20}{60}$

Step 4 – simplify the tooth ratio: $\dfrac{20}{60} = \dfrac{1}{3}$

Step 5 – evaluate: $N_2 = \dfrac{1500}{3} = 500$ rpm

Final Answer: $N_2 = 500$ rpm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept – swept (displacement) volume of a cylinder: The swept volume is the volume traced by the piston between top and bottom dead centre, $V_s = \dfrac{\pi}{4}D^2L$, with D the bore and L the stroke.

Step 1 – list the data in centimetres: $D = 100$ mm $= 10$ cm, $L = 120$ mm $= 12$ cm.

Step 2 – write the formula: $V_s = \dfrac{\pi}{4}D^2L$

Step 3 – compute D^2: $D^2 = 10^2 = 100$ cm^2

Step 4 – substitute the values: $V_s = \dfrac{\pi}{4} \times 100 \times 12$

Step 5 – multiply the numbers inside: $100 \times 12 = 1200$

Step 6 – apply $\pi/4 = 0.7854$: $V_s = 0.7854 \times 1200$

Step 7 – evaluate: $V_s = 942.5$ cm$^3 \approx 942$ cm^3

Final Answer: $V_s \approx 942$ cm$^3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – compression ratio of a reciprocating engine: The compression ratio is the ratio of the total cylinder volume (swept plus clearance) to the clearance volume: $r = \dfrac{V_s + V_c}{V_c}$.

Step 1 – list the data: $V_s = 900 \text{ cm}^3$, $V_c = 100 \text{ cm}^3$.

Step 2 – add to get the total volume: $V_s + V_c = 900 + 100 = 1000 \text{ cm}^3$

Step 3 – write the compression-ratio formula: $r = \dfrac{V_s + V_c}{V_c}$

Step 4 – substitute the values: $r = \dfrac{1000}{100}$

Step 5 – evaluate: $r = 10$

Final Answer: $r = 10 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept – puddling implements for wetland rice: Puddling is the churning of soil under standing water to create a soft, impervious mud layer that reduces percolation and helps transplanting.

Step 1 – identify the puddling tool: The cage wheel (puddler), fitted in place of the tractor's or power tiller's ground wheels, stirs the wet soil to puddle it.

Step 2 – rule out the other options: The mouldboard plough is a primary dry-tillage tool; the seed drill places seed in prepared soil; the disc harrow is a secondary tillage tool for clod breaking, none of which is a puddling implement.

Final Answer: the cage wheel (puddler) is used for puddling $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept – total working width of a multi-bottom plough: The total width worked is the number of bottoms times the width of cut of one bottom: $W = n \times w$.

Step 1 – list the data: Number of bottoms $n = 3$, width per bottom $w = 30$ cm $= 0.30$ m.

Step 2 – write the relation: $W = n \times w$

Step 3 – substitute the values: $W = 3 \times 0.30$

Step 4 – evaluate: $W = 0.90$ m

Final Answer: $W = 0.90$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept – time from area and field capacity: The time to work a field equals the field area divided by the effective field capacity: $t = \dfrac{\text{Area}}{\text{EFC}}$.

Step 1 – list the data: Area $= 4$ ha, EFC $= 0.5$ ha/h.

Step 2 – write the relation: $t = \dfrac{\text{Area}}{\text{EFC}}$

Step 3 – substitute the values: $t = \dfrac{4}{0.5}$

Step 4 – evaluate: $t = 8$ h

Final Answer: $t = 8$ h $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept – resolving an inclined pull into components: A pull R inclined at angle θ to the horizontal has a horizontal component $R\cos\theta$ and a vertical component $R\sin\theta$.

Step 1 – list the data: $R = 10$ kN, $\theta = 30°$, with $\sin 30° = 0.50$.

Step 2 – write the vertical component: $V = R\sin\theta$

Step 3 – substitute the values: $V = 10 \times 0.50$

Step 4 – evaluate: $V = 5.0$ kN

Final Answer: $V = 5.0$ kN $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept – plant population from spacing: The number of plants per unit area equals the area divided by the ground area occupied by one plant, which is (row spacing) $\times$ (plant spacing).

Step 1 – list the data: Row spacing $= 60$ cm $= 0.60$ m, plant spacing $= 20$ cm $= 0.20$ m, area $= 1$ ha $= 10000$ m^2.

Step 2 – find the area per plant: $a = 0.60 \times 0.20 = 0.12$ m^2

Step 3 – divide the hectare area by area per plant: $N = \dfrac{10000}{0.12}$

Step 4 – evaluate: $N = 83{,}333$ plants per hectare

Final Answer: $N \approx 83{,}333 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept – spray nozzle patterns: Each nozzle type produces a characteristic spray pattern suited to a particular job.

Step 1 – match the pattern to the job: The flat-fan nozzle sprays a narrow, tapered flat sheet of droplets and gives an even deposit across a band, which is ideal for pre-emergence and post-emergence herbicide application.

Step 2 – rule out the other options: Hollow-cone and solid-cone nozzles give circular patterns used mainly for insecticide and fungicide foliage coverage, while the flood-jet nozzle gives a wide low-pressure fan used for fertiliser solutions, none of which is the preferred herbicide band nozzle.

Final Answer: the flat-fan nozzle $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept – power strokes in a two-stroke engine: In a two-stroke-cycle engine the whole cycle (compression and power) is completed in one crankshaft revolution, so there is one power stroke every revolution.

Step 1 – recall the two-stroke cycle: The two strokes (up and down) complete intake–compression and power–exhaust together in one revolution.

Step 2 – count power strokes per revolution: Exactly one expansion (power) stroke occurs in each revolution of the crankshaft.

Step 3 – contrast with the four-stroke engine: A four-stroke engine gives one power stroke every two revolutions, i.e. half as often, confirming the two-stroke value of 1.

Final Answer: 1 power stroke per revolution $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept – porosity from bulk and particle density: Porosity is the fraction of the total soil volume occupied by pores, $n = \left(1 - \frac{\rho_b}{\rho_s}\right) \times 100\%$, where ρ_b is the dry bulk density and ρ_s the particle density.

Step 1 – list the data: $\rho_b = 1.6$ g/cm^3, $\rho_s = 2.65$ g/cm^3.

Step 2 – form the density ratio: $\frac{\rho_b}{\rho_s} = \frac{1.6}{2.65}$

Step 3 – evaluate the ratio: $\frac{1.6}{2.65} = 0.6038$

Step 4 – subtract from one: $1 - 0.6038 = 0.3962$

Step 5 – express as a percentage: $n = 0.3962 \times 100 = 39.6\% \approx 40\%$

Final Answer: $n \approx 40\% \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept – relation between void ratio and porosity: Void ratio and porosity are related by $e = \frac{n}{1-n}$, where n is expressed as a fraction.

Step 1 – list the data: $n = 0.40$.

Step 2 – write the relation: $e = \frac{n}{1-n}$

Step 3 – compute the denominator: $1 - n = 1 - 0.40 = 0.60$

Step 4 – substitute the values: $e = \frac{0.40}{0.60}$

Step 5 – evaluate: $e = 0.667$

Final Answer: $e = 0.667 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept – parts of a storm hydrograph: A single-peaked hydrograph rises from the base flow along the rising limb to the peak, then falls back along the recession limb.

Step 1 – locate the marked part: Segment X lies before the peak and climbs from the base flow towards the crest.

Step 2 – name that segment: The ascending part before the peak is the rising limb, shaped mainly by the rainfall and the response of the catchment.

Why the other options are wrong:

- A: the recession (falling) limb comes after the peak, not before it.
- C: base flow is the steady groundwater contribution shown by the dashed line, not the ascending storm limb.
- D: the peak discharge is the single highest point, not the whole rising segment.

Final Answer: X is the rising limb $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept – time of concentration: The time of concentration is the time for runoff to travel from the hydraulically most distant point of a watershed to the outlet; at this time the whole catchment is contributing to flow at the outlet.

Step 1 – interpret the definition: It fixes the duration of the design storm used in the rational method, because the peak occurs when rainfall duration equals the time of concentration.

Why the other options are wrong:

- A: basin lag is the time between the rainfall centroid and the peak flow, not the travel time from the remotest point.
- B: the base time is the total duration of the direct-runoff hydrograph.
- D: the recession time describes the falling limb only.

Final Answer: time of concentration $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept – support-practice factor of the USLE: In $A = R\,K\,LS\,C\,P$, the support-practice factor P measures the effect of conservation practices such as contouring, strip cropping and terracing that change the direction or reduce the amount of runoff.

Step 1 – identify P: P is the ratio of soil loss with a given support practice to that with straight-row up-and-down cultivation.

Step 2 – separate it from the others: C is the cover-management factor for crops and residue, K is the soil erodibility, and R is the rainfall erosivity, none of which describes contouring or terracing.

Final Answer: the support-practice factor $P \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept – function of a check dam in a gully: A check dam is a small barrier built across a gully to control the grade and velocity of flow.

Step 1 – see how it acts: By ponding water behind it, the check dam lowers the flow velocity upstream so the water can no longer carry its sediment load.

Step 2 – state the consequence: The sediment settles behind the structure, the gully bed is raised and stabilised, and further deepening of the gully is arrested.

Why the other options are wrong:

- B: a check dam reduces the erosive energy of runoff, it does not increase runoff.
- C: it stores only a small amount of water temporarily, not a season-long irrigation supply.
- D: sediment trapping and grade control, not foot access, are its purpose.

Final Answer: reduce velocity and trap sediment to stabilise the gully $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept – land slope as a percentage: Percent slope is the vertical drop divided by the horizontal distance, multiplied by 100: slope $= \frac{\text{rise}}{\text{run}} \times 100\%$.

Step 1 – list the data: Vertical drop (rise) $= 2$ m, horizontal distance (run) $= 50$ m.

Step 2 – write the relation: slope $= \frac{2}{50} \times 100$

Step 3 – simplify the ratio: $\frac{2}{50} = 0.04$

Step 4 – convert to percentage: slope $= 0.04 \times 100 = 4\%$

Final Answer: slope $= 4\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – permissible velocity in a grassed waterway: The permissible (non-erosive) velocity is the highest mean flow velocity a channel lining can withstand without its bed and sides being scoured.

Step 1 – interpret the term: For a vegetated (grassed) waterway this limit depends on the type of grass cover and the soil, and the channel is sized so its design velocity does not exceed it.

Why the other options are wrong:

- A: critical velocity is the velocity at which flow changes between subcritical and supercritical (Froude number $= 1$), not the erosion limit.
- B: terminal velocity is the settling velocity of a particle in a fluid.
- C: mean velocity is simply the average flow velocity, which may be above or below the erosion limit.

Final Answer: permissible (non-erosive) velocity $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept – runoff coefficient of a storm: The runoff coefficient for a storm is the ratio of the direct-runoff depth to the rainfall depth: $C = \dfrac{\text{runoff depth}}{\text{rainfall depth}}$.

Step 1 – list the data: Rainfall depth $= 60$ mm, runoff depth $= 24$ mm.

Step 2 – write the relation: $C = \dfrac{24}{60}$

Step 3 – simplify the fraction: $\dfrac{24}{60} = 0.40$

Step 4 – state the result: $C = 0.40$ (dimensionless, and correctly between 0 and 1)

Final Answer: $C = 0.40 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept – continuity relation between discharge, area and velocity: For steady flow the discharge equals the flow area times the mean velocity, $Q = AV$, so the required area is $A = \dfrac{Q}{V}$.

Step 1 – list the data: $Q = 0.5\ \text{m}^3/\text{s}$, $V = 1.0\ \text{m/s}$.

Step 2 – rearrange for the area: $A = \dfrac{Q}{V}$

Step 3 – substitute the values: $A = \dfrac{0.5}{1.0}$

Step 4 – evaluate: $A = 0.5\ \text{m}^2$

Final Answer: $A = 0.5\ \text{m}^2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q22

Q23.

Solution

Concept – runoff volume from depth and area: The runoff volume equals the runoff depth times the catchment area, using consistent units.

Step 1 – list the data: Runoff depth $= 40$ mm $= 0.04$ m, area $= 25$ ha.

Step 2 – convert the area to square metres: $25\ \text{ha} = 25 \times 10000 = 2{,}50{,}000\ \text{m}^2$

Step 3 – write the volume relation: $V = \text{depth} \times \text{area}$

Step 4 – substitute the values: $V = 0.04 \times 2{,}50{,}000$

Step 5 – evaluate: $V = 10{,}000 \text{ m}^3$

Final Answer: $V = 10{,}000 \text{ m}^3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept – net irrigation depth from allowable depletion: The net irrigation depth applied at scheduling equals the allowable depletion fraction times the total available water in the root zone: $d_n = f \times \text{TAW}$.

Step 1 – list the data: Total available water TAW $= 10$ cm, allowable depletion $f = 50\% = 0.50$.

Step 2 – write the relation: $d_n = f \times \text{TAW}$

Step 3 – substitute the values: $d_n = 0.50 \times 10$

Step 4 – evaluate: $d_n = 5$ cm

Final Answer: $d_n = 5 \text{ cm} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept – irrigation interval: The irrigation interval is the number of days the applied net depth lasts against the crop's daily water use: $I = \dfrac{d_n}{\text{ET}}$.

Step 1 – list the data: Net irrigation depth $d_n = 50$ mm, peak evapotranspiration ET $= 5$ mm/day.

Step 2 – write the relation: $I = \dfrac{d_n}{\text{ET}}$

Step 3 – substitute the values: $I = \dfrac{50}{5}$

Step 4 – evaluate: $I = 10$ days

Final Answer: $I = 10 \text{ days} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept – duty and discharge: Duty D is the area that a unit discharge can irrigate over the base period, so the discharge to irrigate an area A is $Q = \dfrac{A}{D}$.

Step 1 – list the data: Duty $D = 800$ ha/cumec, area $A = 400$ ha.

Step 2 – write the relation: $Q = \dfrac{A}{D}$

Step 3 – substitute the values: $Q = \dfrac{400}{800}$

Step 4 – evaluate: $Q = 0.5\ \text{m}^3/\text{s}$

Final Answer: $Q = 0.5\ \text{m}^3/\text{s} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q26

Q27.

Solution

Concept – relation between delta, duty and base period: Delta is the total depth of water a crop needs over its base period; it is linked to duty D and base period B by $\Delta = \dfrac{8.64\,B}{D}$, with Δ in metres.

Step 1 – list the data: $B = 120$ days, $D = 800$ ha/cumec.

Step 2 – write the relation: $\Delta = \dfrac{8.64\,B}{D}$

Step 3 – substitute the values: $\Delta = \dfrac{8.64 \times 120}{800}$

Step 4 – multiply the numerator: $8.64 \times 120 = 1036.8$

Step 5 – divide by the duty: $\Delta = \dfrac{1036.8}{800}$

Step 6 – evaluate: $\Delta = 1.296\ \text{m} \approx 1.30\ \text{m}$

Final Answer: $\Delta \approx 1.30\ \text{m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept – area of a trapezoidal channel section: For a trapezoidal channel with bottom width b, flow depth y and side slope z (horizontal:vertical), the flow area is $A = (b + z\,y)\,y$.

Step 1 – list the data: $b = 2$ m, $y = 1$ m, $z = 1$.

Step 2 – write the area formula: $A = (b + z\,y)\,y$

Step 3 – compute the top-width term $z\,y$**:** $z\,y = 1 \times 1 = 1$ m

Step 4 – add to the bottom width: $b + z\,y = 2 + 1 = 3$ m

Step 5 – multiply by the depth: $A = 3 \times 1$

Step 6 – evaluate: $A = 3$ m^2

Final Answer: $A = 3$ m^2 $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q28

Q29.

Solution

Concept – water (output) power of a pump: The useful power imparted to the water is $P = \rho_w\, g\, Q\, H$, with Q the discharge and H the total head.

Step 1 – list the data: $Q = 50$ L/s $= 0.05$ m^3/s, $H = 10$ m, $\rho_w = 1000$ kg/m^3, $g = 9.81$ m/s^2.

Step 2 – write the formula: $P = \rho_w\, g\, Q\, H$

Step 3 – substitute the values: $P = 1000 \times 9.81 \times 0.05 \times 10$

Step 4 – multiply 1000×9.81**:** $1000 \times 9.81 = 9810$

Step 5 – multiply by the discharge: $9810 \times 0.05 = 490.5$

Step 6 – multiply by the head: $490.5 \times 10 = 4905$ W

Step 7 – convert to kilowatts: $P = 4.905$ kW ≈ 4.9 kW

Final Answer: $P \approx 4.9$ kW $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept – pump affinity law for head: For a given pump the head varies as the square of the rotational speed: $\dfrac{H_2}{H_1} = \left(\dfrac{N_2}{N_1}\right)^2$.

Step 1 – list the data: $N_1 = 1450$ rpm, $H_1 = 5$ m, $N_2 = 2900$ rpm.

Step 2 – form the speed ratio: $\dfrac{N_2}{N_1} = \dfrac{2900}{1450} = 2$

Step 3 – square the speed ratio: $\left(\dfrac{N_2}{N_1}\right)^2 = 2^2 = 4$

Step 4 – apply it to the head: $H_2 = H_1 \times 4$

Step 5 – substitute and evaluate: $H_2 = 5 \times 4 = 20$ m

Final Answer: $H_2 = 20 \text{ m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

Concept – transmissivity of a confined aquifer: Transmissivity is the product of the hydraulic conductivity and the saturated thickness of the aquifer: $T = K\,b$.

Step 1 – list the data: $K = 20$ m/day, $b = 15$ m.

Step 2 – write the relation: $T = K \times b$

Step 3 – substitute the values: $T = 20 \times 15$

Step 4 – evaluate: $T = 300 \text{ m}^2/\text{day}$

Final Answer: $T = 300 \text{ m}^2/\text{day} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept – design discharge from a drainage coefficient: The drainage coefficient is the depth of water to be removed per day; the design discharge is that depth times the area, converted to a rate per second.

Step 1 – list the data: Drainage coefficient $= 1.5$ cm/day $= 0.015$ m/day, area $= 80$ ha $= 8{,}00{,}000 \text{ m}^2$.

Step 2 – find the daily volume: Volume $= 0.015 \times 8{,}00{,}000$

Step 3 – evaluate the daily volume: Volume $= 12{,}000 \text{ m}^3/\text{day}$

Step 4 – convert one day to seconds: 1 day $= 24 \times 60 \times 60 = 86{,}400$ s

Step 5 – divide the volume by the seconds: $Q = \dfrac{12{,}000}{86{,}400}$

Step 6 – evaluate: $Q = 0.1389 \text{ m}^3/\text{s} \approx 0.139 \text{ m}^3/\text{s}$

Final Answer: $Q \approx 0.139 \text{ m}^3/\text{s} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – overall irrigation efficiency: The overall (project) efficiency is the product of the conveyance efficiency and the application efficiency: $\eta_o = \eta_c \times \eta_a$.

Step 1 – list the data: Application efficiency $\eta_a = 80\% = 0.80$, conveyance efficiency $\eta_c = 75\% = 0.75$.

Step 2 – write the relation: $\eta_o = \eta_c \times \eta_a$

Step 3 – substitute the values: $\eta_o = 0.75 \times 0.80$

Step 4 – evaluate: $\eta_o = 0.60$

Step 5 – express as a percentage: $\eta_o = 60\%$

Final Answer: $\eta_o = 60\% \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept – Darcy's law for discharge: The volumetric flow through a porous medium is $Q = K\,i\,A$, with K the hydraulic conductivity, i the hydraulic gradient and A the flow cross-sectional area.

Step 1 – list the data: $K = 10$ m/day, $i = 0.05$, $A = 20\ \text{m}^2$.

Step 2 – write the relation: $Q = K\,i\,A$

Step 3 – substitute the values: $Q = 10 \times 0.05 \times 20$

Step 4 – multiply 10×0.05**:** $10 \times 0.05 = 0.5$

Step 5 – multiply by the area: $0.5 \times 20 = 10$

Step 6 – state the result with units: $Q = 10\ \text{m}^3/\text{day}$

Final Answer: $Q = 10\ \text{m}^3/\text{day} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept – dry matter from wet-basis moisture: On a wet basis the dry-matter fraction is $(1 - M_{wb})$, so the dry-matter mass is the total mass times this fraction.

Step 1 – list the data: Total mass $= 500$ kg, moisture (wet basis) $M_{wb} = 20\% = 0.20$.

Step 2 – find the dry-matter fraction: $1 - M_{wb} = 1 - 0.20 = 0.80$

Step 3 – write the dry-matter mass: Dry matter $= 500 \times 0.80$

Step 4 – evaluate: Dry matter $= 400$ kg

Final Answer: dry matter $= 400$ kg $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q35

Q36.

Solution

Concept – water removed in drying at constant dry matter: During drying the bone-dry matter stays constant, so the final total mass is found from the required final moisture, and the water removed is the drop in total mass.

Step 1 – list the data: Initial mass $= 1000$ kg at $M_{wb} = 25\%$; final moisture $= 15\%$ (wet basis).

Step 2 – find the initial dry matter: Dry matter $= 1000 \times (1 - 0.25) = 1000 \times 0.75 = 750$ kg

Step 3 – note the dry matter is unchanged: The 750 kg of solids remains the same before and after drying.

Step 4 – relate final mass to final moisture: At 15% moisture the dry matter is 85% of the final mass, so $750 = 0.85 \times M_f$.

Step 5 – solve for the final mass: $M_f = \dfrac{750}{0.85} = 882.35$ kg

Step 6 – find the water removed: Water removed $= 1000 - 882.35$

Step 7 – evaluate: Water removed $= 117.65$ kg ≈ 117.6 kg

Final Answer: water removed ≈ 117.6 kg $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q36

Q37.

Solution

Concept – converting wet-basis moisture to dry basis: The two moisture bases are related by $M_{db} = \dfrac{M_{wb}}{1 - M_{wb}}$, with the fractions expressed as decimals.

Step 1 – list the data: $M_{wb} = 20\% = 0.20$.

Step 2 – write the relation: $M_{db} = \dfrac{M_{wb}}{1 - M_{wb}}$

Step 3 – compute the denominator: $1 - 0.20 = 0.80$

Step 4 – substitute the values: $M_{db} = \dfrac{0.20}{0.80}$

Step 5 – evaluate: $M_{db} = 0.25 = 25\%$

Final Answer: $M_{db} = 25\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept – free (unbound) moisture in a solid: Free moisture is the water held loosely in surface films and open capillaries; it exerts the same vapour pressure as pure water and is the portion that can be removed during the constant-rate drying period.

Step 1 – identify the term: Because the description says the vapour pressure equals that of pure water, the moisture is unbound, i.e. free moisture.

Why the other options are wrong:

- A: bound moisture is held in cell walls and small capillaries and exerts a vapour pressure lower than pure water.
- B: equilibrium moisture is the residual moisture reached in balance with the surrounding air; it cannot be removed at that condition.
- D: critical moisture is the value marking the end of the constant-rate period, not the loosely held surface water itself.

Final Answer: free (unbound) moisture $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept – Kick's law of size reduction: Kick's law states that the energy needed for size reduction is proportional to the logarithm of the ratio of feed size to product size: $E = K_K \ln\left(\dfrac{d_1}{d_2}\right)$.

Step 1 – interpret the law: It assumes the energy per unit mass depends only on the reduction ratio, not on the actual particle sizes, and applies best to coarse crushing.

Why the other options are wrong:

- B: proportionality to the new surface area created is Rittinger's law, used for fine grinding.
- C: energy is not proportional to the square of the feed size in any of these laws.
- D: a single reciprocal-diameter term does not describe Kick's law; the surface-area difference of reciprocals belongs to Rittinger's law.

Final Answer: energy $\propto \ln(d_1/d_2) \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q39

Q40.

Solution

Concept – specific-gravity (gravity) separator: A gravity separator uses an inclined, oscillating porous deck through which air is blown upward; the air fluidises the mixture so heavier particles sink to the deck and are conveyed uphill while lighter particles float and move downhill.

Step 1 – match the description: Separation on the basis of specific-gravity difference using an oscillating deck and an air stream is exactly the specific-gravity (gravity) separator.

Why the other options are wrong:

- A: a magnetic separator removes ferromagnetic impurities using a magnetic field, not density.
- C: a disc separator grades particles by length using indented pockets.
- D: a spiral separator sorts round from non-round grains by their rolling behaviour on a helical chute.

Final Answer: specific-gravity (gravity) separator $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept – conveying capacity of a bucket elevator: The mass flow rate is the mass carried per unit belt length times the belt speed. With buckets of mass m spaced a distance s apart, the number discharging per second is v/s, and the capacity is $m \times (v/s)$.

Step 1 – list the data: Bucket load $m = 2$ kg, spacing $s = 0.4$ m, belt speed $v = 1.6$ m/s.

Step 2 – find the buckets discharging per second: $\frac{v}{s} = \frac{1.6}{0.4} = 4$ buckets/s

Step 3 – find the mass flow rate: $\dot{m} = m \times \frac{v}{s} = 2 \times 4 = 8$ kg/s

Step 4 – convert to kilograms per hour: $8 \times 3600 = 28{,}800$ kg/h

Step 5 – convert to tonnes per hour: $\dot{m} = \frac{28{,}800}{1000} = 28.8$ t/h

Final Answer: capacity $= 28.8$ t/h $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q41

Q42.

Solution

Concept – sensible heat to warm a mass of water: The sensible heat is $Q = m\,c\,\Delta T$, with m the mass, c the specific heat and ΔT the temperature rise.

Step 1 – list the data: $m = 50$ kg, $c = 4.18$ kJ/kg · K, $\Delta T = 20$ K.

Step 2 – write the formula: $Q = m\,c\,\Delta T$

Step 3 – substitute the values: $Q = 50 \times 4.18 \times 20$

Step 4 – multiply 50×4.18: $50 \times 4.18 = 209$

Step 5 – multiply by the temperature rise: $209 \times 20 = 4180$

Step 6 – state the result with units: $Q = 4180$ kJ

Final Answer: $Q = 4180$ kJ $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q42

Q43.

Solution

Concept – latent heat of vaporization: To boil off water already at its boiling point, only latent heat is needed: $Q = m\,h_{fg}$, with h_{fg} the latent heat of vaporization.

Step 1 – list the data: $m = 2$ kg, $h_{fg} = 2257$ kJ/kg.

Step 2 – write the formula: $Q = m\,h_{fg}$

Step 3 – substitute the values: $Q = 2 \times 2257$

Step 4 – evaluate: $Q = 4514$ kJ

Final Answer: $Q = 4514$ kJ $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept – critical moisture content: On a drying-rate curve the critical moisture content is the value at which the constant-rate period ends and the falling-rate period begins.

Step 1 – read the marked point: Point X is where the horizontal constant-rate portion turns down into the falling-rate portion.

Step 2 – name it: That transition moisture is by definition the critical moisture content; beyond it the surface can no longer be kept fully wet and the drying rate falls.

Why the other options are wrong:

- B: the equilibrium moisture content is reached at the very end of drying, where the rate becomes zero.
- C: free moisture is the removable moisture above equilibrium, not the transition point.
- D: bound moisture is held within the solid structure and is not the constant-to-falling transition value.

Final Answer: critical moisture content $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q44

Q45.

Solution

Concept – UHT sterilization of milk: Ultra-high-temperature (UHT) processing heats milk very rapidly to about 138–150°C for only a few seconds to destroy virtually all micro-organisms and spores, giving a long, shelf-stable product.

Step 1 – match the time–temperature figures: The stated 138–150°C for 2–4 s and commercial sterility point directly to the UHT process.

Why the other options are wrong:

- A: LTLT (holder) pasteurization uses about 63°C for 30 minutes.
- B: HTST pasteurization uses about 72°C for 15 seconds.
- C: blanching is a mild pre-treatment of fruits and vegetables to inactivate

enzymes, not a milk-sterilizing process.

Final Answer: UHT sterilization $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q45

Q46.

Solution

Concept – sensible cooling on the psychrometric chart: In sensible cooling no moisture is added or removed, so the humidity ratio W stays constant while the dry-bulb temperature falls (a horizontal line to the left).

Step 1 – track the humidity ratio: W is unchanged, so the actual amount of water vapour per kg of dry air is the same at states 1 and 2.

Step 2 – track the saturation capacity: As the temperature falls, the saturation vapour pressure of the air decreases, so the air can now hold much less moisture than before.

Step 3 – combine the two effects: Relative humidity is the ratio of the actual vapour present to the saturation amount. With the numerator fixed and the denominator shrinking, this ratio rises.

Step 4 – state the conclusion: Therefore the relative humidity increases during sensible cooling (until, if cooling continued to the dew point, it would reach 100%).

Why the other options are wrong:

- B: RH would fall on heating, not cooling.
- C: RH is not constant, because the saturation capacity changes with temperature even though W does not.
- D: the trend is monotonic for pure sensible cooling; there is no reversal.

Final Answer: the relative humidity increases $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q46

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	C	3	A	4	B	5	D
6	A	7	B	8	D	9	A	10	D
11	B	12	A	13	B	14	D	15	B
16	C	17	B	18	A	19	A	20	D
21	C	22	C	23	B	24	D	25	D
26	C	27	C	28	B	29	B	30	D
31	C	32	C	33	D	34	A	35	D
36	C	37	B	38	C	39	A	40	B
41	A	42	B	43	A	44	A	45	D
46	A								